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AN
ADDRESS
TO THE
PROPRIETORS AND MANAGERS
OF
COAL-MINES.

PRICE TWO SHILLINGS.

Wholly My own 1809
Ch. 10

AN
ADDRESS
TO THE
PROPRIETORS AND MANAGERS
OF
COAL-MINES,

PARTICULARLY OF
THOSE IN THE NEIGHBOURHOOD OF
NEWCASTLE UPON TYNE,

RESPECTING THE MEANS OF DESTROYING THE

FIRE-DAMP;

IN REPLY TO A PROPOSAL

LATELY CIRCULATED

By DR. TROTTER.

LONDON:

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1806.

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T. Bensley, Printer,
Bolt Court, Fleet Street.

AN ADDRESS,

&c.

GENTLEMEN,

THE pamphlet of Doctor Trotter, entitled a “ Proposal for destroying the Fire and Choke-Damps of Coal Mines,” though published so long ago as November 1805, has only just now been put into my hands. Had it reached me at an earlier period, I should have lost no time in the performance of that duty, which it will be the object of the following pages to fulfil. For a duty it assuredly is, and one of no small importance, to warn you against a proposal, which, as to the object it is intended to

accomplish, is wholly inefficient ; which holds forth a remedy far more deleterious than the evil it is designed to counteract ; and which has a tendency to abate your diligence, in the use of the only means of security against these noxious gases, that are sanctioned by reason and experience.

It is no part of my plan to follow Dr. Trotter through the hypothetical reasoning, by which he has endeavoured to explain the production of the fire and choke-damps of coal mines. In the present state of chemical philosophy, we are not able to develop that chain of causes, by which the immense masses of coal that are found below the surface of the earth, and their accompanying strata, were originally formed ; nor the alterations, if any, which they are at present undergoing from spontaneous decomposition. It must be acknow-

ledged, that the most probable source of the fire and choke-damps is the decomposition of water ; but whether the agent in this decomposition be the coal itself, or some contiguous bodies, it is impossible, on any known data, to decide*. In this state of uncertainty, we may concede to Dr. Trotter, for the sake of confuting him by fair inferences from his own premises, the hypothesis which he suggests, that the carbonaceous matter, or coal, is oxygenized by stagnant water ; and that the results are carbonic acid or choke-damp, and the inflammable gas, the combustion of which occasions such tremendous catastrophes.

We have not to proceed far, however, in the Doctor's pamphlet, before we find him departing from the principles, which he

* See note A, at the end of this pamphlet.

labours to establish at the outset. He has assumed (pages 9 and 19) that the fire-damp is identical with *pure hydrogen gas*; and he expressly asserts (page 21) that “in the coal mines of this district, it is probably generated in great purity.” Now it is not possible that *pure* hydrogen gas can be generated, by the process which Dr. Trotter assumes to be the mode of production of fire-damp; and which he dignifies with the title of “a simple explanation of one of the sublimest operations in physics.” For in every decomposition of water by carbonaceous matter, beside carbonic acid, there is formed, not “pure hydrogen gas, which is 13 or 16 times lighter than common air*,” but a gas compounded of hy-

* Where did Dr. Trotter obtain this information? According to Mr. Kirwan, who states the specific gravity of hydrogen gas to be to that of common air as 84 to 1000, the former is barely twelve times as light. A similar

drogen and carbon, or a solution of charcoal in hydrogen gas, which is only about two thirds lighter than the air of our atmosphere. Such is the compound gas obtained when water is transmitted over red hot charcoal ; such the gas from stagnant water ; and such (if Dr. Trotter's hypothesis be true) the gas which is the basis of fire-damp.

Whenever this carburetted hydrogen gas, or fire-damp, is submitted to combustion, the result is not water only, as when pure hydrogen gas is burned ; for, in addition to the water, formed by the union of oxygen with the hydrogen of the gas, there is

misstatement may be found (page 22) of the specific gravity of carbonic acid, which is affirmed to be "more than double the weight of atmospheric air." But, if Mr. Kirwan's authority be of any value, the specific gravity of carbonic acid gas only exceeds that of common air, in the proportion of 1500 to 1000. See Kirwan's "Essay on Mineral Waters," *passim*.

another product, which, of all others, it is least desirable to introduce into a coal-mine, viz. the carbonic acid gas, or choke-damp. This product is obtained in whatever mode the oxygenizement of the carburetted hydrogen is effected; and that it is formed by the action of oxygenized muriatic acid gas the antidote (proposed by Dr. Trotter) on the compound inflammable gas, or fire-damp, we have the testimony of Mr. Cruickshank, who has shown *, that when nearly four measures of the proposed antidote are kept, during 24 hours, in contact with one measure of fire-damp, or hydro-carburet gas, there result eight tenth parts of a measure of carbonic acid gas or choke-damp. The operation of Dr. Trotter's antidote would consist, therefore, in converting

* Nicholson's Journal 4to series, vol. v, p. 204.

one noxious gas (the fire-damp) into another (the choke-damp) of still more noxious properties.

But, independently of this injurious conversion, the oxygenized muriatic acid, in the state of gas, is itself one of the most pernicious of all aëriform substances. When taken into the lungs, even though largely diluted with atmospheric air, it produces a sense of suffocation, and excites most violent coughing, which terminates sometimes in a discharge of blood from that organ. Admitting, for a moment, therefore, that it annihilates fire-damp, still if the proportion be not nicely adjusted, if any excess of the remedy be employed (and it can scarcely happen otherwise), that excess must inevitably prove detrimental to the persons who respire it. On the other hand, a deficient proportion of the oxygenized acid would

convert the fire damp into another gas, still distinguished by the properties of being inflammable and unrespirable, viz. the *carbonic oxide* of Cruickshank *.

After alleging any thing so fatal to the proposal of the antidote, as a demonstration that it does not destroy the gas, against which it is directed, but changes it into one still more deleterious, it may seem superfluous to produce arguments of inferior force, but which nevertheless would have been sufficient to prove the inadequacy of the proposed remedy to the evil, had the results of its agency been innocent in their properties. As it is not improbable, however, that Dr. Trotter may still, in direct contradiction to his own theory, maintain the identity of fire-damp with *pure* hydrogen gas, it may not be unnecessary to show,

* Nicholson's Journal, vol. v, p. 204.

that, even on this supposition, he has projected a remedy which cannot be applied in practice; and which, if it could be applied, would still be liable to the charge of incompetency.

The author of the "Proposal" has been led to suggest the oxygenized muriatic acid gas, as a means of destroying fire-damp, by an observation of Mr. Cruickshank of Woolwich, communicated in the following words. "The effects of the oxygenized muriatic acid upon all inflammable gases are worthy of attention. If the pure oxygenized acid, in the form of gas, be mixed, in certain proportions, with any of these inflammable gases, and introduced into a bottle filled with and inverted over water; although no immediate action may be perceptible, yet, in twenty-four hours, a complete decomposition and change of principles will be

found to have taken place, the products varying according to the nature of the inflammable gas employed*.” But it is impossible to believe that the Doctor can ever have read the original paper of Mr. Cruickshank, or that he can have procured his information through any other than second hand channels; because, otherwise, he could not have failed to perceive, that the gas employed by that ingenious chemist in condensing the various inflammable gases was procured by a process perfectly different from the one, which the Doctor recommends as furnishing an antidote against the fire damp. The gas used by Mr. Cruickshank was invariably obtained “by adding the common muriatic acid to the hyperoxygenized muriate of potash,” and not from muriatic acid,

* Nicholson, vol. v, p. 202.

or materials capable of affording it, and manganese. Now this is not a trifling difference, but a real and important ground of distinction; for the gas procured in Mr. Cruickshank's mode differs essentially, in composition and in power of action on combustible bodies, from that procured by the process recommended by the author of the "Proposal." The former gas has been ascertained to comprise, in 100 parts, very nearly 43 of oxygen*; whereas the common oxygenized acid, prescribed by Dr. Trotter, contains only 16 per cent. of oxygen, the remaining 84 being common muriatic acid. In fact, the two gases, thus differently generated, are perfectly distinct compounds; and, accordingly, it has been proposed by Mr.

* These proportions are assigned by Mr. Cruickshank, who states 2.3. parts of this gas to contain one part of oxygen.
loc. cit.

Chenevix *, whose investigations have led to this inference, to discriminate them by different names; the gas proposed by Dr. Trotter as an antidote to fire-damp being called simply *oxygenized muriatic acid*, and that employed by Mr. Cruickshank having the epithet of *hyperoxygenized*. The latter gas, from containing nearly three times the quantity of oxygen present in the other, cannot fail to exert effects proportionally powerful; and may probably even accomplish changes, which the simply oxygenized gas is incompetent to produce. For every chymist is satisfied, by a variety of examples, that because a compound of two elements in a given

* Phil. Trans. 1801. Dr. Trotter, it may be observed by the way, appears to be entirely ignorant of those improvements in chymical nomenclature, which have been proposed by Mr. Chenevix, and are now universally adopted by the chymists of this country. See Mr. Chenevix's "Remarks on Chymical Nomenclature." 8vo. 1802.

proportion has certain properties, it cannot thence be inferred that a similar power will reside, in any degree, in another compound of the same elements united in different proportions. Mr. Cruickshank, indeed, from his own experience, gives a caution, that the gas, employed to condense hydrocarbonet (or fire-damp, according to Dr. Trotter's theory) should be used in its most highly oxygenized state ; and that it should even be rejected, when it has suffered that partial decomposition, or loss of oxygen, which arises from keeping it long before use *. Though it may be admitted, therefore, as a chymical fact, that the hyperoxygenized gas has the property of destroying fire-damp, yet it cannot thence be deduced, that the same property appertains, in any degree, to the simply oxygenized muriatic acid.

* Nicholson, vol. v, p. 202, note.

But, admitting the proposed antidote to possess a similar power, and to differ only in the *amount*, to which it is capable of exerting it, a little calculation will show, that, for the correction of so vast an evil, the remedy proposed is altogether insignificant. Indeed it borders, to say the least, upon the ludicrous, to attempt with an earthen pipkin, containing not eight ounces of the materials of fumigation, to annihilate the gas which spreads through immense caverns, or a long labyrinth of subterraneous passages *. According to Westrumb, the oxygen, contained in four ounces of manganese, is capable, by union with muriatic acid, of forming 160 cubical inches of the oxygenized muriatic acid gas; that is, a pound of manganese would form 640 cubic inches,

* These passages, I am credibly informed, extend in the Walker colliery nearly sixty miles.

and a hundred weight (112lb.) would yield 41 cubic feet and a half. But the simply oxygenized gas, being necessarily inferior in power to that used by Mr. Cruickshank, in the proportion of 16 to 43, the product of a hundred weight of manganese would be equivalent only to $15\frac{1}{2}$ cubic feet of the hyper-oxygenized acid gas. Now, according to the same chymist, the latter gas has the power of destroying, or condensing, no more than half its bulk of hydrogen; and hence all that can possibly be accomplished, by the full action of the gas from 1 cwt. of manganese, and a proportional quantity of common salt and vitriolic acid, would be the destruction of seven cubic feet and three quarters of fire-damp, in case it should be identical with pure hydrogen gas. But if, as Dr. Trotter's theory implies, the fire-damp consist, not of pure hydrogen but of carburetted

hydrogen gas, then, from data furnished by Mr. Cruickshank, it follows, that the gas from this large quantity of materials would destroy only one fourth of its bulk, or less than four cubic feet, and would condense the fire-damp, not into water only, but into water and carbonic acid or choke-damp, the latter of which would amount to more than three cubic feet.

It may perhaps be alleged by Dr. Trotter, that the fire-damp forms only a small proportion of the mixed atmosphere of a coal mine, and that it is unfair to reason, respecting the powers of its correctors, on the presumption that the gas is pure. On this subject, however, we are fortunately in possession of some appropriate facts, furnished by one of the founders of the pneumatic philosophy, Mr. Cavendish, who has taught us the proportions between hydrogen

gas and common air, necessary to their explosion on the application of an inflamed body. That eminent philosopher ascertained, that a loud and violent detonation does not ensue, when hydrogen gas bears a less proportion to common air than that of 3 to 7, or when it constitutes less than one third of the total bulk of the mixture; and that an explosion still takes place with equal bulks of the two. Hence it may be inferred, that when the fire-damp explodes in a coal-mine, it composes between one third and one half of the mixed atmosphere; and its absolute quantity must, therefore, be very considerable.

It is not easy to understand how Dr. Trotter can have so far miscalculated, as to state that the quantity of oxygenized acid, from the materials which he has prescribed page 42, is adequate to purify from fire-

damp a space sixteen feet by twelve. The utmost quantity of gas, which that weight of materials is capable of yielding, is 116 cubical inches. And supposing (what the author has omitted to state) the height of the space to be ten feet, its cubic contents would be 1920 feet. This space, filled with two thirds common air and one third hydrogen gas, the proportions necessary to explode, would contain 640 cubic feet of hydrogen gas ; for the condensation of which twice its bulk, or 1280 cubic feet, of hyperoxygenized acid would be required, and 3440 of the simply oxygenized gas, procured from the materials recommended in the “ Proposal.” But Dr. Trotter proposes to accomplish this with less than one fourteenth part of a cubic foot, *or with about a forty-eight thousandth part of the quantity absolutely essential for the purpose.* An error,

of the same enormous amount, extends to his estimate of the cost of the fumigation. This, in an extensive coal-mine, he has stated cannot exceed 100/. annually ; but 48000 times the quantity assumed by Dr. Trotter to be sufficient being absolutely essential, the expense would be equal to 48000 multiplied by 100, or to FOUR MILLIONS EIGHT HUNDRED THOUSAND POUNDS PER ANNUM, FOR A SINGLE MINE ; and the weight of manganese, thus consumed, would far exceed what is annually raised in this kingdom.

In his reasonings respecting the destruction of fire-damp it may not be improper to observe, that the author of the “ Proposal ” has made no allowance for the immense quantities of this noxious gas, which, during the operation of his antidote, must constantly flow into the space intended to be purified.

He has argued, as if the amount of the fire-damp could be accurately gauged ; and the due proportion of the remedy be applied, without any disturbance of the order of these proportions by any subsequent process. But it is well known to every person, at all conversant with the appearances in coal-mines, that, in most instances, there is an unceasing, an enormous production of inflammable gas, which must defy all such adjustment, and destroy in a moment that nicety of proportion, which alone can ensure the full action of gaseous bodies on each other. In truth, the Doctor proposes to you to combat an enemy, whose forces, springing from dark and impenetrable regions, cannot be measured or even estimated, with means of resistance, which are limited in their extent and impotent in their efficacy. He would place you in the fabled

situation of Syfiphus, and inflict upon you the sentence of endless and unprofitable labour.

I trust I have not been unsuccessful in the attempt to prove, that Dr. Trotter has mistaken the nature and chymical constitution both of the noxious gas, which it is the object of his "Proposal" to destroy, and of the means which he has projected for the accomplishment of that effect. And when the nature of a disease, and that of an untried remedy, are both completely misunderstood, the application of the latter to the former cannot be founded on any rational principle, or hold out any encouraging prospect of success. There are several objections to the project of inferior moment, which the weight and importance of those I have already urged render it scarcely necessary to advance. Among others, how-

ever, it may be remarked that, admitting the oxygenized acid to possess the efficacy ascribed to it, and to return, as in that case it must, to the condition of common muriatic acid, this last product, amounting to 84 parts from every hundred parts of the antidote, must impart to the water, present in the mine, a degree of acidity, sufficient to destroy all the pumps employed in its removal.

In the present state of chymical philosophy, whatever may have been its progress during the latter years of the 18th century, (and no one admires, more ardently than myself, the fabric of sound and consistent doctrine into which it has been elevated,) it must be acknowledged, that we have made no steps towards the acquirement of the power of combating those devastating operations, which form a part of the economy

of nature. We have no more control, than in times of the darkest ignorance, over the storm, the earthquake, or the overwhelming desolation of epidemic contagion. We understand not the principles on which these disastrous phenomena are produced in the great laboratory of nature; and, if we did understand them, the means, and the instruments by which they are effected, are of a magnitude and force of operation, with which artificial chymistry would vainly contend. Even in our attempts to moderate the sufferance of these evils, we are scarcely ever benefitted by chymical agents; for chymical instruments are, of all those with which we are furnished, of most limited power. In the present state of our knowledge, I have no hesitation in declaring, that an infallible method of obviating, by chymical means, the deplorable catastrophes that

occur in coal-mines, is a hopeless acquisition ; and that to hold forth any such proposal, with confident pretensions, would be the boast of empiricism and not of science.

Every person, possessed of a tolerable share of information respecting the coal-mines of your district, knows, that of the inflammable gas, which gives occasion to these accidents, a part is produced by regular and uniform processes, and that it issues without intermission, from *partings* or interstices between the different strata or measures of the coal itself. In a well ventilated place little danger can arise from this source ; because the inflammable gas is immediately carried off, as soon as it is extricated, diluted with atmospherical air to such an extent, as no longer to be susceptible of combustion. The danger of explosions arises from the accumulation of this gas, either from neglect of ventilation, or

from its impracticability, in consequence of local peculiarities of unusual occurrence. Thus, in workings that are much intersected by perpendicular fissures or *troubles*, it is not without example that a large cavity filled with fire-damp is suddenly broken into, and that the candles of the workmen set fire to it, and produce a tremendous explosion. Against accidents from such a cause, and from others of equally unexpected occurrence, it must be difficult by any foresight to provide. But I have the sanction of experience in asserting, that plans of ventilation, well devised and diligently enforced, as was done by the late Mr. Barnes, in the Walker colliery, and by some other gentlemen, *and extended not only to the part of the mine actually worked, but to the old works or waste*, afford all the security that can possibly be attained against the ordinary and regular production

of the gas *. Of the two last accidents, which happened near Newcastle, the one, I understand, ensued in consequence of the pillars in the waste giving way to the superincumbent mass, and the pressure of the air, contained in that cavity, into the part of the mine then worked. In this instance, as much mischief was believed to have been effected by the azotic gas, called *stytb* by the workmen, formed in consequence of the deterioration of atmospheric air by contact with the coal or with pyrites, as by the inflammation of the fire-damp itself. The last unfortunate event occurred in an almost new working, very much intersected by *troubles*, and was caused by the workmen suddenly penetrating into a large cavern

* For the sake of those who may be unacquainted with the mode of ventilating coal mines, I have added in the note B an account of the contrivances, by which this is effected in the neighbourhood of Newcastle upon Tyne.

filled with fire-damp. The former might perhaps have been avoided by the indispensable provision of ventilating the waste ; but I do not see, that any precaution would have obviated the latter. In either case, however, what good would have been obtained by a few ounces of salt, manganese, and oil of vitriol ; or indeed by any quantity of these costly materials ?

The insufficiency of ventilation, it is well known, arises rather from the difficulty of steadily enforcing it, and of securing constant and unrelaxed attention on the part of the workmen, than from any physical impediment. Dr. Trotter, however, has assumed, without the smallest reason, that the depth of the pits, and the tortuous course of their passages, render perfect ventilation impracticable ; whereas on no one law of statics, with which I am acquainted,

can it be explained why ventilation should be more difficult at the depth of 1000 fathoms than at that of fifty, or through winding rather than through straight passages, except that, in the former case, a longer time may be required for the transit of a current of air. The question, indeed, regards the amount to which "perflation" may be carried, and not its practicability in the abstract; for in every place where an animal can breathe, or a candle can burn, ventilation must be carried on to no inconsiderable extent; and through the least perfectly ventilated mine, there must be, therefore, a constant current of air from the surface, to supply the expenditure by respiration and combustion. Now, whatever may be accomplished, to a certain degree, by the employment of given means, may be effected to an increased amount, by proportionally

adding to the efficiency of those means. In the present instance, to obtain "perfect perfusion," you have only to carry into effect, with unremitted attention, and if necessary to a greater extent, those simple contrivances, which have long been adopted in the Walker* and other collieries, and which are within your sphere of personal inspection.

Before dismissing the examination of Dr. Trotter's pamphlet, I cannot forbear from protesting against the indelicacy and incon-

* I avail myself of this opportunity of paying a small tribute of respect to the memory of Mr. Barnes; and I am persuaded, that you will acquiesce with me, in praise of the diligence and perseverance, which he exerted in improving the method of ventilating the extensive collieries under his direction; of the humane attention which he invariably paid to the safety of the pit men; and of his intrepidity, presence of mind, and quickness in devising and applying means of security in cases of sudden emergency. When you reflect on the extent of what he accomplished by simple and practicable methods, you must smile at the insignificant antidote proposed with so much parade by Dr. Trotter.

fistency of converting those pages, which are professed to have in view the accomplishment of a humane and benevolent project, into the vehicle of insinuation against the character of a deceased and most respectable member of the medical profession. Though I have no share, either personally or remotely, in the local politics of Newcastle, and very little acquaintance with them, I can perceive the blow which is aimed (pages 32 and 23 line 20 of the pamphlet) against the posthumous reputation of a man, who adorned his profession by that learning, which is best fitted to extend its usefulness; who forbore from wasting his time and his talents in the puerile speculations of a sciolist in philosophy; and who was distinguished, through life, by the *unostentatious* discharge of his professional and moral duties. I am persuaded, that you

will retain, unimpaired, your reverence for the memory of this excellent man and accomplished physician; and that, in your estimate of his character, you will be guided rather by your long experience of his knowledge, skill, and humanity, than by the testimony of one, whose judgment may be influenced by the remembrance of contending interests.

From the examination of the chymical reasoning in Dr. Trotter's pamphlet, which has formed the principal object of the foregoing pages, you will most probably agree with me in opinion, that the author of the "Proposal" in this instance, has laid himself open to the merited censure of having attempted to instruct others in a science, of which his own knowledge is extremely superficial. He has advanced a "Proposal," which Morveau, (by whom he supposes it

might have been anticipated, had that eminent philosopher resided in a coal-district) must regard as futile and absurd, in common with every person who is well versed in the practice, or well informed in the theory of chymistry.

I remain, with much respect, Gentlemen,

Your obedient servant,

A FRIEND TO RATIONAL SCHEMES
OF IMPROVEMENT.

May 5, 1806.

E R R A T A.

Page 8, Remove the first mark of the Parenthesis, so as to follow the word, *gas*, line 7.

15, line 7, for hydro-carbonet, *read* hydro-carburet.

35, line 7, for the truth, *read* its truth.

40, line 9, for "these two consist," *read* "these two generally consist each," &c.

NOTE A.

ON THE MODE OF PRODUCTION OF THE FIRE-
DAMP.

IN exposing the futility of Dr. Trotter's Proposal, I have conceded to him his theory of the mode of production of fire-damp, not from acquiescence in the truth, but for the purpose of confuting him, by inferences drawn from the very data which he assumes. The generation of fire-damp is far from being, as Dr. Trotter asserts, "rendered familiar to us by modern chymistry;" and is not at all explained by the hypothesis of the decomposition of water by carbonaceous matter. The Doctor has been deceived by a fallacious "analogy between a ship's hold and a coal-mine, in the production of these noxious

gases ;” while, in truth, there is no resemblance between the substances present in the one and in the other, consequently no similitude between the processes, which are going on in these different situations. The *bilge vapour* in the hold of a ship does not, as Dr. Trotter affirms, arise from “ water in a state of putrefaction ;” for water is incapable of undergoing that process, but from the putrefaction of the vegetable juices of the timber, which, when diffused through water, are eminently disposed to undergo this change. Coal, on the contrary, does not, like wood, impart to water any principle that is susceptible of putrefaction ; and though capable of undergoing spontaneous changes, yet putrefaction is assuredly not of the number. At the ordinary temperature of the atmosphere, neither charcoal nor genuine coal has the power of decomposing water, as any person may be satisfied by an appeal to experiment *. And that this decompo-

* If carbonaceous matter or charcoal possessed the power of decomposing water, at the ordinary temperature of the

sition is not effected by the masses of coal in their natural situation, we may infer from the fact, that it is not uncommon to meet with coal-mines abounding in stagnant water, and yet perfectly free from fire-damp; a fact wholly irreconcilable with the theory of Dr. Trotter.

A much more probable source of fire-damp, than the decomposition of water by the coal itself, is the agency of the sulphuret of iron or *pyrites*, which, in every instance where fire-damp is found, has, I believe, been observed to accompany coal, sometimes blended with it, and at other times forming distinct strata or masses. That this substance has the power of decomposing water, and of affording hydrogen gas, is ascertained by actual experiment; and its agency in producing fire-damp acquires additional probability from the fact, that this noxious substance

atmosphere, where would be the propriety of the method, recommended by Dr. Trotter, of preparing watercasks for the navy, by charring their interior surfaces?

has evidently, from its smell, an admixture of sulphuretted hydrogen gas, and, after its accidental combustion, leaves a strong odour of the sulphurous acid. It is to be regretted, that no accurate analysis has hitherto been accomplished of the gas which constitutes fire-damp. Such an examination, skilfully performed, would afford a tolerably certain insight into the mode of its production; and should certainly be the basis of any chymical project, that may be formed for its annihilation.

NOTE B.

AN ACCOUNT OF THE METHOD OF VENTILATING COAL-MINES.

AS this pamphlet may perhaps fall into the hands of a few persons, who have never personally inspected a coal-mine, and in this number I strongly suspect that Dr. Trotter himself may be included, it may not be improper to offer a general outline of the method, that is practised with a view to ensure complete ventilation.

In order to support the excavations made by the removal of the coal, it is necessary to leave walls or pillars of solid coal, varying in thickness and frequency, according to the strength of the

roof over the coal, the firmness of the foundation on which they stand, and other circumstances. The cavities between these walls form passages of various width, intersecting each other at right angles, like the streets of a well planned city. In order to carry a current of air through these streets, it is essential that all openings to the atmosphere shall be closed excepting two; and these two consist of a perpendicular pit or shaft. These shafts open at a distance from each other, on the surface of the ground, and are so contrived that their inferior apertures shall be at the two opposite ends of the series of streets which compose the mine. There is, therefore, a free communication between the two shafts through the intermediate passages of the mine. This being effected, it must be evident, that, if the air in one of the shafts be rarefied above what it is in the other, it must ascend in that shaft, and descend in the other, producing a current of air through

all the intermediate passages of the mine. And the deeper the shafts, the greater will be the difference (with the same difference of rarefaction) between the absolute weights of the columns of air in the two shafts; and consequently a current of proportionally greater velocity will be produced.

The air of a coal-mine, being generally warmer than that of the atmosphere, this current, when once put in motion, is kept up by the heat supplied within the mine. How that heat is generated, it is not necessary for me to explain, whether solely from the respiration of the men and other animals employed in the mine, or from chymical decompositions effected by the coal or accompanying strata; but its existence, and efficiency in maintaining a current of air, are established facts. When, in consequence of the increased temperature of the external atmosphere, an equilibrium, or something approaching to it, takes

place between the air of the mine and that above the surface, the current fails; and the requisite heat is then supplied, by making a fire in the shaft, through which the air is to ascend. To increase the effect, a chimney, of considerable height, is frequently built over this mouth of the mine.

When a fresh shaft is sunk, and no communication can be had with any other, the ventilation, if necessary, is assisted by carrying a wooden partition down the middle of the shaft; and, in this case, the temperature, occasioned by the workmen below, is found to be sufficient to maintain a circulation of air up one side of the partition and down the other. The air in this case ascends on that side of the partition under which the men are working, and as soon as they remove to the other side, the current is reversed.

The communication between two shafts, when this advantage can be had, should be so contrived

that the air, in finding its way from the bottom of the one to the bottom of the other, must necessarily pass through every cavity of the mine, and through those parts, called the *waste*, which have long ceased to be wrought, as well as through the parts actually in work. The mode of doing this, by stopping some of the communications, and, when necessary, by making partitions in cavities, is too obvious to require minute description. In the application of the general principle, however, to particular cases, where the excavations are intricate, much skill and judgment are required in the engineer or coal viewer. But as a proof, that a sufficient current of air may be kept up in passages extremely tortuous, I may state, that in one system of ventilation, at the Walker Colliery, the air traverses, in its passage through the mine, a line exceeding thirty miles; although the shaft at which it enters is not half a mile distant from that at which it escapes. Throughout the whole of these

excavations, the air is as safe and salubrious as in the open streets of Newcastle.

The course of the air-current is sometimes intersected by the under-ground waggon roads, for conveying the coals to the bottom of the shafts; and doors are so placed in these roads, that, when shut, the course of the air-current, instead of taking, as it would otherwise, the nearest road to the shaft, continues its proper circuitous passage. If these doors be left open, a stagnation must take place in the less direct passages. During working hours, a boy is stationed at every door, to open it for the waggons; and the door is so contrived as to shut itself. Though these doors are sometimes held open for ten minutes at a time, yet no danger arises, when the current is restored to its proper channel after so short an interval; and it is only from continuing to keep them open longer than necessary, that an accumulation of gas can take place in the lateral passages, the ventilation of

which is thus suspended. The occasional inconveniences from this cause might probably be obviated, by dividing the mine into a greater number of independent systems of ventilation, so disposed, that each waggon road shall form a part of an air-course, and shall not intersect any air-course. This measure must of course be attended with some expense in making partitions, &c.; but this would be of no great amount, and would be cheaply purchased, when it is considered, that it would ensure the lives of numbers of persons, who may now be brought into danger by the trifling circumstance of inadvertently leaving open a door.

But the ventilation of the *waste* is what I would most earnestly recommend to your consideration and attentive enforcement. Independently of the safety of the pit-men, it is really astonishing, that the proprietors of coal mines, by neglect of this measure, will voluntarily exclude themselves from

the power of detecting negligence or fraud in the past workings ; to say nothing of the advantages they forego, in sacrificing the means of exploring with facility the adjacent strata, and thus deriving an insight into the best mode of conducting new undertakings.

THE END.

LETTER

TO

THOMAS TROTTER, M. D.



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